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10/511,512	10/14/2004	Jeroen Anton Johan Leijten	NL02 0321 US	4657

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EXAMINER	
GIROUX, GEORGE	

ART UNIT	PAPER NUMBER
2183	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ip.department.us@nxp.com

Office Action Summary	Application No.	Applicant(s)	
	10/511,512	LEIJTEN, JEROEN ANTON JOHAN	
	Examiner	Art Unit	
	GEORGE D. GIROUX	2183	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 October 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This Office Action is in response to applicant's communication filed 16 October 2009, in response to the Office Action mailed 28 April 2009. The applicant's remarks and any amendments to the claims or specification were considered, with the results that follow.

2. Claims 1-7 remain pending in this application.

Specification

3. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 1-7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. Claim 1 recites the limitation "the holdable registers do not store data on the multiple data output paths of the second set" in the last two lines of the claim. There is

insufficient antecedent basis for this limitation in the claim, because "the holdable registers" may refer to multiple different sets of holdable registers.

7. Claims 2-7 are dependent upon claim 1, and thus include the aforementioned limitation, without curing the noted deficiency.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1, 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dally (US 6,192,384) in view of Garde (US 6,510,510).

As per claim 1, Dally teaches a multi-issue processor comprising a register file as **[a parallel processing computer system (column 1, lines 9-13) including a stream register file 14 (figure 1)]**; and a plurality of issue slots as **[ALU clusters 0-7 (numeral 18, figure 1)]**, each one of the plurality of issue slots including a plurality of functional units as **[each ALU cluster 18 includes a number of ALUs 26 (figures 2-3)]**, an input routing network that provides multiple data path outputs for a single data path input as **[crosspoint switch 30 distributes the inputs to the ALUs 26, from a single input from the stream register file (SRF) (figures 2-3)]**, the input routing network receiving data from the register file on the single data path input via a single data input path and providing data from the register file to functional units of the plurality of functional units,

the data provided on the multiple data path outputs via multiple data output paths as **[crosspoint switch 30 outputs the operands to the ALUs 26, from a single input from the stream register file (SRF) 14 (figures 1-3 and column 4, lines 38-58)]**, and a plurality of holdable registers that hold duplicate data from the register file, wherein in a first set of the plurality of issue slots the holdable registers store data on the multiple data output paths of the first set as **[local register files 28 buffer the inputs to the ALUs 26 and store local constants, parameters and variables for the cluster, where the local register files 28 are fed by the crosspoint switch 30 (figures 1-3 and column 4, lines 38-58)]** and the holdable register do not store data on the single input path corresponding to the input routing networks of the first set **[local register files 28 buffer the inputs to the ALUs 26, directly at the inputs, and store local constants, parameters and variables for the cluster, where the local register files 28 are fed by the crosspoint switch 30 (figures 1-3 and column 4, lines 38-58)]**.

Dally does not explicitly teach a second set of the plurality of issue slots the holdable registers store data on the single data input path corresponding to the input routing networks of the second set and the holdable registers do not store data on the multiple data output paths of the second set.

Garde teaches a second set of the plurality of issue slots the holdable registers store data on the single data input path corresponding to the input routing networks of the second set as **[operand latch 132 holds the output of the registers 130 on the input to the routing network of op busses 110 and 112 to the computation units (column 6, lines 3-14 and figure 2)]** and the holdable registers do not store data on

the multiple data output paths of the second set as **[operand latch 132 holds the output of the registers 130 on the input to the routing network of op busses 110 and 112 to the computation units (column 6, lines 3-14 and figure 2), which is not on the inputs of the ALUs (i.e. the multiple data output paths)]**.

Dally and Garde are analogous art, as they are within the same field of endeavor, namely connecting a register file to multiple functional/computation units.

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to use the operand latches for the register file output of Garde on the outputs of the stream register file/input to the crosspoint switches for some of the clusters taught by Dally.

Because both Dally and Garde teach systems with a register file output connected to a series of inputs of a number of functional/computational units, and both including latches/registers on the inputs of the individual functional/computational units, it would have been obvious to one of ordinary skill in the art to use the operand latches for the register file output of Garde on the outputs of the stream register file/input to the crosspoint switches for some of the clusters taught by Dally, to achieve the predictable result of latching the output of the stream register file before it is sent via the crosspoint switches to the various ALUs. This extra level of registers between the register file and computational units also can provide an additional pipeline stage, allowing higher clock frequency, if desired, as described in the applicant's admitted prior art on page 2, lines 8-25, of the specification.

As per claim 3, Dally teaches wherein the input routing network of each of the plurality of issue slot has a plurality of data path inputs as **[the stream register file sends data to the ALU clusters via the crosspoint switches (figures 1-3) and crosspoint switch 30 outputs the operands to the ALUs 26, from a single input from the stream register file (SRF) 14 as well as an input from outputs of the other ALUs in the cluster (figures 1-3 and column 4, lines 38-58)]** and

Dally does not explicitly teach that in the second set of issue slots holdable registers of the plurality of holdable registers are located between each of the inputs of the input routing network and the register file.

Garde teaches the second set of issue slots' holdable registers of the plurality of holdable registers are located between each of the inputs of the input routing network and the register file as **[operand latch 132 holds the output of the registers 130 on the input to the routing network of op busses 110 and 112 to the computation units (column 6, lines 3-14 and figure 2)]**.

Dally and Garde are analogous art, as they are within the same field of endeavor, namely connecting a register file to multiple functional/computation units.

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to use the operand latches for the register file output of Garde on the outputs of the stream register file/input to the crosspoint switches for some of the clusters taught by Dally.

Because both Dally and Garde teach systems with a register file output connected to a series of inputs of a number of functional/computational units, and both

including latches/registers on the inputs of the individual functional/computational units, it would have been obvious to one of ordinary skill in the art to use the operand latches for the register file output of Garde on the outputs of the stream register file/input to the crosspoint switches for some of the clusters taught by Dally, to achieve the predictable result of latching the output of the stream register file before it is sent via the crosspoint switches to the various ALUs. This extra level of registers between the register file and computational units also can provide an additional pipeline stage, allowing higher clock frequency, if desired, as described in the applicant's admitted prior art on page 2, lines 8-25, of the specification.

As per claim 4, Dally teaches wherein, in the first set of issue slots, holdable registers are located between the input routing networks and each of the plurality of function units as **[local register files 28 buffer the inputs to the ALUs 26 and store local constants, parameters and variables for the cluster, where the local register files 28 are fed by the crosspoint switch 30 (figures 1-3 and column 4, lines 38-58)]**.

10. Claims 2 and 5-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dally (US 6,192,384) in view of Garde (US 6,510,510), and further in view of Fisher (US 6,026,479).

As per claim 2, Dally teaches the multi-issue processor of claim 1, as described above.

Dally does not teach a first instruction set accessing at least the first set of issue slots; and a second instruction set accessing the second set of issue slots, however.

Fisher teaches "a first instruction set accessing at least the first set of issue slots; and a second instruction set accessing the second set of issue slots" as **["A CPU having a cluster VLIW architecture…which operates in both a high instruction level parallelism (ILP) mode and a low ILP mode. In high ILP mode, the CPU executes wide instruction words using all operational clusters of the CPU and all of a main instruction cache and main data cache of the CPU are accessible to a high ILP task. The CPU also includes a mini-instruction cache, a mini-instruction register and a mini-data cache which are inactive during high ILP mode. An instruction level controller in the CPU receives a low ILP signal, such as an interrupt or function call to a low ILP routine, and switches to low ILP mode. In low ILP mode, the main instruction cache and main data cache are deactivated to preserve their contents. At the same time, a predetermined cluster remains active while the remaining clusters are also deactivated. The low ILP task executes instructions from the mini-instruction cache which are input to the predetermined cluster through the mini-instruction register. The mini-data cache stores operands for the low ILP task"(abstract, lines 1-19)]**.

Dally and Fisher are analogous art, as they are within the same field of endeavor, namely instruction processing.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to combine the parallel processor with a register file connected to a

number of ALU clusters via crosspoint switches controlling the inputs of the functional units of each ALU in the clusters, taught by Dally, with the multiple instruction sets and multiple groupings of resources for each, as taught Fisher.

The motivation for doing so is provided by Fisher as **["the separate mini-instruction cache and mini-data cache along with the use of only the predetermined cluster minimizes the pollution of the main instruction and data caches, as well as pollution of register files in the deactivated clusters, with regard to a task executing in high ILP mode"(abstract, lines 20-24)]**.

As per claim 5, Dally teaches the multi-issue processor of claim 1, as described above.

Dally does not teach wherein the first set of issue slots are accessed by a first set of instructions for a VLIW processor and the second set of issue slots are accessed by a second set of instructions that are used by an interrupt routine, however.

Fisher teaches wherein the first set of issue slots are accessed by a first set of instructions for a VLIW processor and the second set of issue slots are accessed by a second set of instructions that are used by an interrupt routine as **["A CPU having a cluster VLIW architecture…which operates in both a high instruction level parallelism (ILP) mode and a low ILP mode. In high ILP mode, the CPU executes wide instruction words using all operational clusters of the CPU and all of a main instruction cache and main data cache of the CPU are accessible to a high ILP task. The CPU also includes a mini-instruction cache, a mini-instruction register**

and a mini-data cache which are inactive during high ILP mode. An instruction level controller in the CPU receives a low ILP signal, such as an interrupt or function call to a low ILP routine, and switches to low ILP mode. In low ILP mode, the main instruction cache and main data cache are deactivated to preserve their contents. At the same time, a predetermined cluster remains active while the remaining clusters are also deactivated. The low ILP task executes instructions from the mini-instruction cache which are input to the predetermined cluster through the mini-instruction register. The mini-data cache stores operands for the low ILP task" (abstract, lines 1-19)].

Dally and Fisher are analogous art, as they are within the same field of endeavor, namely instruction processing.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to combine the parallel processor with a register file connected to a number of ALU clusters via crosspoint switches controlling the inputs of the functional units of each ALU in the clusters, taught by Dally, with the multiple instruction sets and multiple groupings of resources for each, as taught Fisher.

The motivation for doing so is provided by Fisher as **["the separate mini-instruction cache and mini-data cache along with the use of only the predetermined cluster minimizes the pollution of the main instruction and data caches, as well as pollution of register files in the deactivated clusters, with regard to a task executing in high ILP mode"(abstract, lines 20-24)]**.

As per claim 6, Fisher teaches wherein the second set of instructions has fewer instructions than the first set of instructions as **[An embodiment of a method for reducing cache pollution in a CPU, according to the present invention, includes providing a main instruction cache configured to store VLIW instructions, wherein each VLIW instruction is further comprised of a plurality of c-instructions, providing a plurality of operational clusters, wherein each one of the plurality of operational clusters is configured to receive one of the plurality of c-instructions of each VLIW instruction in the main instruction cache, and executing a high ILP task by loading VLIW instructions from the main instruction cache into a main instruction register for output to the plurality of clusters. The method includes receiving a low ILP signal and, responsive thereto, deactivating the main instruction cache and main instruction register, deactivating the plurality of operational clusters, except for a predetermined one of the operational clusters, activating a mini-instruction cache and a mini-instruction register, and serially executing a low ILP task by serially loading c-instructions from the mini-instruction cache into the mini-instruction cache for output to the predetermined one of the operational clusters (column 4, lines 16-34)]**.

As per claim 7, Dally teaches the multi-issue processor of claim 1, as described above.

Dally does not explicitly teach wherein the first set of issue slots has more issue slots than the second set of issue slots, however.

Fisher teaches wherein the first set of issue slots has more issue slots than the second set of issue slots as **["The CPU also includes a mini-instruction cache, a mini-instruction register and a mini-data cache which are inactive during high ILP mode. An instruction level controller in the CPU receives a low ILP signal, such as an interrupt or function call to a low ILP routine, and switches to low ILP mode. In low ILP mode, the main instruction cache and main data cache are deactivated to preserve their contents. At the same time, a predetermined cluster remains active while the remaining clusters are also deactivated. The low ILP task executes instructions from the mini-instruction cache which are input to the predetermined cluster through the mini-instruction register. The mini-data cache stores operands for the low ILP task"(abstract, lines 6-19) wherein deactivating some clusters means the cluster running the low ILP tasks (the second set of issue slots) is smaller than the first]**.

Dally and Fisher are analogous art, as they are within the same field of endeavor, namely instruction processing.

At the time of the invention it would have been obvious to a person of ordinary skill in the art to combine the parallel processor with a register file connected to a number of ALU clusters via crosspoint switches controlling the inputs of the functional units of each ALU in the clusters, taught by Dally, with the multiple instruction sets and multiple groupings of resources for each, as taught Fisher.

The motivation for doing so is provided by Fisher as **["the separate mini-instruction cache and mini-data cache along with the use of only the**

predetermined cluster minimizes the pollution of the main instruction and data caches, as well as pollution of register files in the deactivated clusters, with regard to a task executing in high ILP mode"(abstract, lines 20-24)].

Response to Arguments

11. Applicant's arguments filed 16 October 2009 have been fully considered but they are not persuasive.

12. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

13. Applicant argues that Dally teaches away from the combination provided in the rejections, namely regarding slots where the holdable registers are on the single data input path corresponding to the input routing networks of a subset of the issue slots.

However, a reference only "teaches away" when it states that something cannot be done. See *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1130 (Fed. Cir. 1994). Furthermore, the applicant has not provided a reason why such a modification would undermine the purpose of the invention of Dally, or how they would change the principle of operation of Dally. The examiner contends that the operand latches taught by Garde

would maintain the same principle of operation when combined with the Dally reference, as data is still being held in a "tier" of holdable registers. It has further been held that omission of an element and its function in a combination where the remaining elements perform the same function as before involves only routine skill in the art. *In re Karlson*, 136 USPQ 184.

Conclusion

14. The following is a summary of the treatment and status of all claims in the application as recommended by **M.P.E.P. 707.07(i)**: claims 1-7 are rejected.

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Balmer (US 2002/0108026) -- discloses holdable registers on register file outputs for transferring data between datapaths.

b. Hao (4,594,655) -- discloses staging registers on the outputs of the register file for holding operands to be sent to the ALUs.

17. The examiner requests, in response to this Office action, that support be shown for language added to any original claims on amendment and any new claims. That is, indicate support for newly added claim language by specifically pointing to page(s) and line number(s) in the specification and/or drawing figure(s). This will assist the examiner in prosecuting the application.

18. When responding to this office action, Applicant is advised to clearly point out the patentable novelty which he or she thinks the claims present, in view of the state of the art disclosed by the references cited or the objections made. He or she must also show how the amendments avoid such references or objections. See 37 CFR 1.111(c).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GEORGE D. GIROUX whose telephone number is

(571)272-9769. The examiner can normally be reached on Monday through Friday, 9:30am - 6:00pm E.S.T.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie P. Chan can be reached on 571-272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Eddie P Chan/
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/George D Giroux/
Examiner, Art Unit 2183